# 2017 State Implementation Plan Emissions Inventory for TAG

**Submitted to: United States Environmental Protection Agency Region 10**
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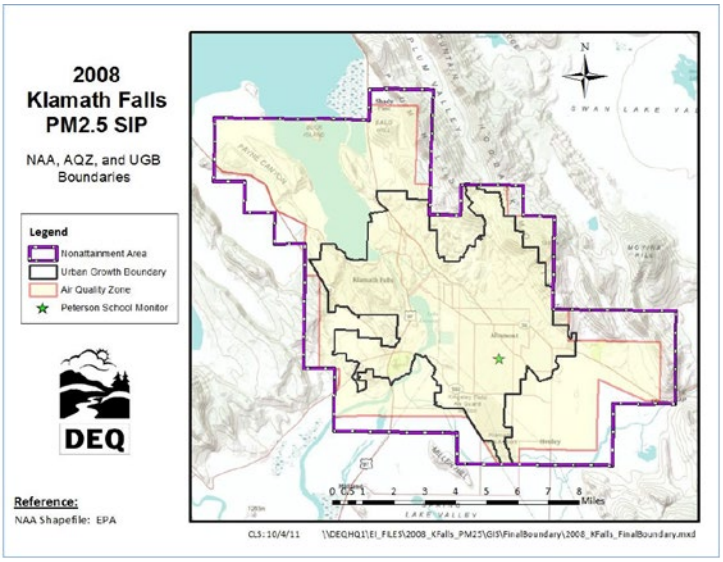
# 1. Emissions Inventory Background

Title I of the Clean Air Act Amendments of 1990 (CAAA) contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Klamath Falls Non-Attainment Area (NAA) is a designated NAAQS $PM_{2.5}$ attainment area with a maintenance plan. In compliance with published EPA requirements the emissions inventory is part of the State's revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

DEQ is currently in the process of updating the former emissions inventory for the 2012 Attainment SIP for which the base and future year inventoried were 2008 and 2014 respectively. This new SIP emission inventory will include emission updates for a 2017 base year with future year projections out to 2037. While the update to the SIP emissions inventory is still in progress, DEQ will use preliminary 2017 annual and typical season day emission estimates where available for the grant proposal inventory. Emissions are subject to change upon completion of the SIP inventory.

# 2. Estimation Methodology and Approach

DEQ is using preliminary 2017 base year emissions for this grant proposal for the geographic boundary of the Klamath Falls NAA. (See map below) This inventory will consist of 2017 base year actual annual and typical season day emission estimates for $PM_{2.5}$ and precursors of secondary formation of particulate for various data categories. Though the focus of this inventory is on $PM_{2.5}$, other criteria pollutants considered precursors will need to be included as well. Ammonia, nitrogen dioxide, and sulfur dioxide are precursors that form secondary particulate matter through chemical reactions with ambient air well after emitted by emission sources.




## 2.1 Data Categories Inventoried

The data categories inventoried are events, nonpoint, nonroad and onroad, and point sources. These categories include activities such as stationary fuel combustion, waste disposal treatment and recovery, agricultural and biogenic activities, fugitive sources, mobile sources, and prescribed fires and wildfires. These various activities contribute $PM_{2.5}$ emissions and some secondary formation of particulate through industrial/commercial/institutional fuel

combustion activities (i.e. boilers, engines, etc.), residential wood combustion such as woodstoves, road and construction dust, structural fires, and open burning.

The 2017 inventory also includes stationary point source emissions from Oregon air-permitted facilities within the Klamath Falls NAA and any point sources considered significant and thought to have an impact on the NAA. These facilities represent various industries such as crematories, wood products manufacturing, redi-mix concrete plants, rock crushers, and electricity generation and natural gas transmission. The major portion of $PM_{2.5}$ point source emissions in the NAA comes from wood products industries such as sawmills and plywood/hardboard mills. They include equipment such as wood-fired boilers, particle or veneer dryers, hardboard presses, and lumber kilns. DEQ assumes that all stationary point sources operate as specified in their permit.

DEQ updated the list of $PM_{2.5}$ data categories using the 2008 Klamath Falls Nonattainment Inventory and the 2014 and 2017 National Emissions Inventory (NEI). DEQ rearranged some data categories due to changes to source classification code (SCC) from 2008 through 2017. DEQ removed some activities such as prescribed fires and wildfires from the nonpoint category and included them under their own separate category, Events. In addition, DEQ removed some nonpoint sectors because no $PM_{2.5}$ or precursor emissions occurred from those emission sources in the 2008 inventory. Such sectors removed are volatile organic compound (VOC) sources like gasoline dispensing facilities and off-gassing sources.

Finally, DEQ removed or added stationary point sources due to operations either ceasing or beginning after the 2008 inventory. DEQ added three new facilities and removed eight facilities due to closure making it 17 facilities included in the 2017 emissions inventory.

# 2.2 Data Resources and Estimation Approach

DEQ used several data resources to develop emission estimates for the inventory including: 1) 2017 NEI county level emissions for some data categories, 2) MOVES2014b for mobile sources, and 3) prepared some estimates in-house where agency data was readily available. Methodologies for preparing this inventory comes from *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations*[1] or the *Emission Inventory Improvement Program*[1] EPA documents. The following data categories further discuss the data resources and methods used to estimate 2017 emissions:

## 2.2.1 Nonpoint and Events

Unless otherwise noted, DEQ used 2017 NEI Klamath county-level emissions for both nonpoint and events categories. Data resources for two sectors deviated from the decision above, residential wood combustion and biogenic sources. DEQ prepared 2017 emissions data for residential wood combustion last year for the NEI and used it for this inventory. Currently, there are no 2017 emissions available from the NEI for biogenic sources; therefore, DEQ used agricultural zoning acreage and an emission factor developed for this sector from the 2008 SIP EI to estimate 2017 emissions.

### 2.2.2 Point

DEQ prepared and submitted 2017 emissions for the NEI last year and are included in this inventory. To develop 2017 estimates, DEQ extracted emissions factors or estimation methodologies from Oregon State and Federal air operating permits to develop emission basis for 2017 calculations. DEQ retrieved annual activity from annual reports submitted by facilities to calculate $PM_{2.5}$ and precursor emissions.

### 2.2.3 Nonroad and Onroad

DEQ used the MOVES2014b model to estimate both nonroad and onroad 2017 emissions. EPA created the model for state and local agencies to develop inventories for State Implementation Plans and Transportation Conformity Budgets. DEQ used MOVES2014b default data for nonroad model inputs except for local fuel standards provided in-house and meteorology data (i.e. temperature and humidity) collected from Kingsley Air Field in Klamath Falls NAA. The only sectors not ran in MOVES were airports and rail. DEQ used data from the 2017 NEI to estimate emissions for these two sectors.

For Onroad, DEQ used the MOVES2014b model to update the mobile inventory by generating onroad mobile emission rates data for 2017. DEQ and Oregon Department of Transportation (ODOT) in a cooperative effort developed mobile source emission estimates and projections for formulating mobile source emission budgets. The process includes developing localized activity data for vehicles through modeling that simulates travel patterns in the region. Estimates for the number of vehicle miles traveled (VMT) and the number of vehicle trips are key outputs from this type of modeling. These activity outputs combined with other data inputs such as the age of the vehicles, the speed of travel, and other vehicle descriptives to run in the MOVES2014b model by DEQ. The results produce tabulated emission factors based on activity levels to estimate the final emissions.

ODOT ran the traffic demand model from the previous non-attainment plan to get 2017 VMT inputs for the MOVES model. DEQ processed the model output data converting it into emission factors and using it with ODOT VMT to estimate mobile source emissions for the Klamath Falls NAA. This process provides a localized tool for estimating the area's travel demand incorporating potential travel changes under various policy options and land use, and demographic changes. DEQ will provide a summary of the travel model validation to EPA with the current Klamath Falls Attainment Plan.

DEQ then spatially allocated county-level emission estimates for the various categories to the NAA by census and state employment data, or land use/land cover (LU/LC) data, and Traffic Analysis Zones (TAZs) in conjunction with Geographic Information Systems (GIS) analysis.

## 2.3 Annual and Typical Season Day Estimates

This inventory includes annual and typical season day emission (TSD) estimates for $PM_{2.5}$ and its precursor pollutants. Annual and TSD emissions categorize estimates for a particular period. Annual emissions are total emissions for a year and typically recorded as tons per year (tpy). The calculation includes an annual activity such as vehicle miles travelled in a given area for mobile sources or fuel usage for nonpoint/point sources and emission factor or calculation method to estimate emissions.

TSD is an accounting of emissions variation over time. The simplest temporal allocation is for a steady-state emissions source that continually releases emissions at the same rate all the time. However, under actual conditions steady state emission sources are quite rare. Instead, under actual conditions, emissions sources may operate only in the winter, not operate on Sundays, or their activity may peak during certain hours of the day. TSD emissions represent an average daily emission value during the winter PM season

and recorded in pounds per day (lbs/day). The winter PM season for the NAA occurs from January through February and November through December of the calendar year 2017 and is usually when violations of the PM standards occur. TSD estimates are calculated using annual emissions and apply a seasonal adjustment factor (SAF) with annual activity days for each data category and sector. The formula is as follows:

Typical Season Day Emissions (lbs/day) = (Annual emissions (tpy) * SAF * 2000 lbs/ton) / (# Activity days per year)

DEQ developed SAFs using temporal files of peak season activity by source classification code (SCC) from the Sparse Matrix Operator Kernal Emissions (SMOKE) modeling program. The temporal data is in the form of annual activity by month and used in SAF formula as such:

SAF = ((PM season activity)*(12 months) / (annual activity)*(# of season months))

Information for TSD estimates and SAF development came from DEQ's air permitting database, the Klamath Falls travel demand model, EPA's MOVES model and SMOKE files.

# 3. Analysis of Emissions Inventory

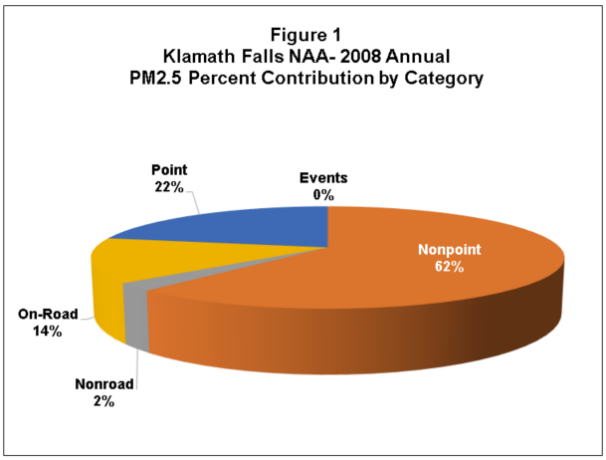
To reiterate from the discussion above, DEQ is still in the process of updating the 2012 Attainment SIP EI and these estimates are preliminary and subject to change upon finalization. For the 2017 baseline inventory, DEQ rolled up emissions into five major categories: events, nonpoint, nonroad, onroad, and point sources. There were no fire activities (prescribed or wildfire) for the events category within the Klamath Falls NAA for 2017. However, several fires did occur around Klamath County that same year and their impact on the NAA needs further evaluation for the SIP EI. The focus of this discussion is on categories and sectors that contribute significantly to 2017 $PM_{2.5}$ annual emission levels in the NAA.

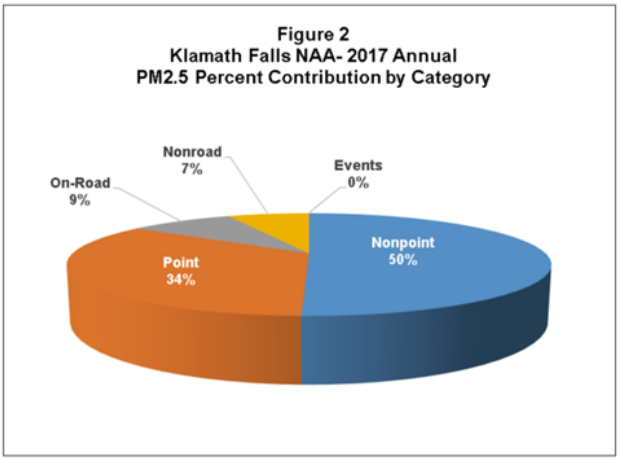
Table 1 compares 2008 and 2017 annual emission estimates for the pollutants $PM_{2.5}$, $NO_X$, $SO_2$, and $NH_3$ in the Klamath Falls NAA. It also includes 2017 average daily emissions for the winter PM season by category for all pollutants. The comparison shows annual $PM_{2.5}$ emissions have decreased from 2008 to 2017 by 193.1 tons. Overall, emissions have decreased for all the precursors as well.

Table 1. 2008 and 2017 Klamath Falls Non-Attainment Area $PM_{2.5}$ and Precursor Emissions

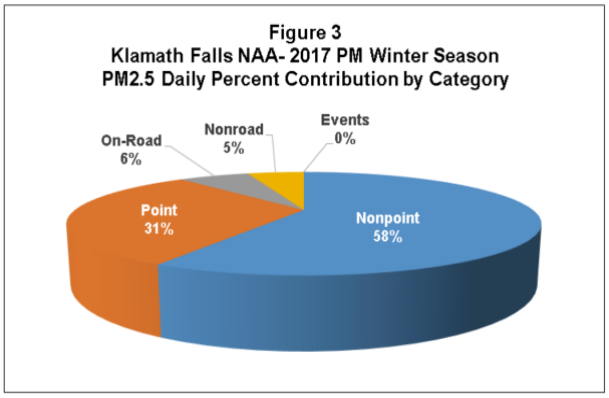
| Data Categories | Klamath Falls NAA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008 | | | | 2017 | | | | | | | |
| | $PM_{2.5}$ | $NH_3$ | $NO_X$ | $SO_2$ | $PM_{2.5}$ | | $NH_3$ | | $NO_X$ | | $SO_2$ | |
| | Annual Emissions | | | | Annual Emissions | Typical Season Day | Annual Emissions | Typical Season Day | Annual Emissions | Typical Season Day | Annual Emissions | Typical Season Day |
| | Tons | | | | Tons | Pounds | Tons | Pounds | Tons | Pounds | Tons | Pounds |
| Nonpoint | 403.0 | 161.9 | 114.3 | 49.1 | 232.7 | 1897 | 76.9 | 248 | 84.8 | 711 | 14.6 | 108 |
| Point | 143.4 | 70.4 | 329.3 | 47.8 | 158.5 | 1002 | 111.7 | 537 | 257.6 | 1551 | 14.8 | 84 |
| On-Road | 92.2 | 11.4 | 1431.6 | 6.4 | 39.4 | 201 | 12.4 | 60 | 504.8 | 2698 | 1.1 | 6 |
| Nonroad[1] | 16.1 | 0 | 360.9 | 6.6 | 31.0 | 163 | 0.5 | 3 | 807.8 | 4,311 | 11.6 | 57 |
| Events[2] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| **Grand Totals** | **654.7** | **243.7** | **2236.1** | **109.9** | **461.6** | **3263** | **201.5** | **848** | **1655.0** | **9271** | **42.1** | **255** |

1. Includes Airports and Rail.
2. Prescribed fires and wildfires included under Nonpoint data category in 2008 SIP EI.




Results of this comparison indicate that for both years nonpoint and point source categories drive $PM_{2.5}$ emissions within the NAA. The pie chart in Figure 1 shows that in 2008 nonpoint and point sources in the NAA contributed 62% and 22% respectively to $PM_{2.5}$ emissions. As compared to Figure 2, the same categories in 2017 are 50% and 34% for the entire NAA. While nonpoint contribution to emissions has decreased since 2008, point sources emissions have actually increased in 2017. This may be due to a better economy in 2017 than in 2008. In 2008, Oregon was experiencing a recession that may explain the lower emissions for point sources in the NAA during that time. Since then, changes in production activities and installation of new equipment for some facilities and the introduction of new facilities to the NAA may explain these increases in 2017. Figure 3 confirms these same categories contribute significantly to average daily $PM_{2.5}$ emissions during the 2017 winter PM season.




# 3.1 Nonpoint and Point Contribution to NAA PM2.5 Emission Levels

DEQ further analyzed these two categories to identify what activities are contributing significantly to $PM_{2.5}$ emissions within the NAA. The following is a breakdown of categories into the sectors that most affect the NAA.

## 3.1.1 Nonpoint

For easier comparison with 2017 activities, DEQ organized Table 2 below using the same sectors inventoried in 2008. The nonpoint category is broken down into the following sectors: residential wood combustion, miscellaneous area sources, fugitive dust, waste disposal, small stationary combustion sources, and an exception is including two activities (i.e. mining and residential grilling) not inventoried in 2008.

Residential wood combustion and the miscellaneous area sources sector contributed significantly to 2008 emissions from the nonpoint category. Residential wood combustion accounts for 41% of emissions while miscellaneous area sources made up 31% of $PM_{2.5}$ emissions within the NAA in 2008. Prescribed fires

and wildfires made up 86% of emissions in 2008 within the miscellaneous area sources sector but now shows no emissions in 2017 within the NAA under the events category. This is why the miscellaneous area sources appears to drop significantly in 2017 to 11%. However, as mentioned earlier in this section, several fires did occur around Klamath County in 2017 and DEQ needs to evaluate whether they significantly affect NAA emission levels. Therefore, decreases in emissions under the miscellaneous area source sector in 2017 is not due solely to any physical change in emissions but because fires were removed and put in their own category.

| 2008 Nonpoint Category Sectors | Klamath Falls NAA | | | | | |
|---|---|---|---|---|---|---|
| | PM2.5 Emissions | | | | | |
| | 2008 | | 2017 | | | |
| | Annual Emissions | Percent of Total (AE) | Annual Emissions | Percent of Total (AE) | Typical Season Day | Percent of Total (TSD) |
| | Tons | % | Tons | % | Pounds | % |
| Residential Wood Combustion | 165.0 | 41% | 140.8 | 60% | 1,464 | 77% |
| Miscellaneous Area Sources | 124.4 | 31% | 25.1 | 11% | 133 | 7% |
| Fugitive Dust | 97.7 | 24% | 29.6 | 13% | 97 | 5% |
| Waste Disposal, Treatment, Recovery | 12.8 | 3% | 29.4 | 13% | 161 | 8% |
| Small Stationary Fossil Fuel Combustion | 3.1 | 1% | 3.6 | 2% | 29 | 2% |
| Not in 2008 EI | 0 | 0% | 4.3 | 2% | 14 | 1% |
| **Grand Totals** | **403.0** | | **232.8** | | **1897** | |

*Table 2. Klamath Falls Non-Attainment Area 2008 and 2017 $PM_{2.5}$ Emissions Breakdown by Nonpoint Sectors*

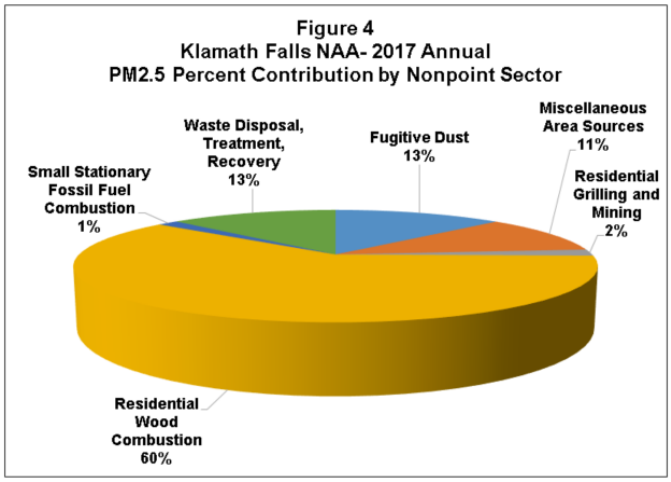



Figure 4 provides the percent contribution of each sector to NAA $PM_{2.5}$ emission levels in 2017. Residential wood combustion accounts for 60% of $PM_{2.5}$ emissions while the remainder sectors contribute cumulatively 40% to NAA emission levels. Residential wood combustion in 2008 and 2017 still account for the significant contribution to $PM_{2.5}$ emission levels in the NAA.

### 3.1.2 Point

The second contributor to emissions within the NAA are point sources, which DEQ organized in Table 3 by North American Industrial Classification System (NAICS) code and description. These NAICS represent various industries such as crematories, wood products manufacturing, redi-mix concrete plants, rock crushers, and electricity generation and natural gas transmission. The major portion of $PM_{2.5}$ point source emissions in the NAA comes from wood products industries such as sawmills and plywood/hardboard mills. They include equipment such as wood-fired boilers, particle or veneer dryers, hardboard presses, and lumber kilns.

| NAICS Codes and Descriptions | Klamath Falls NAA 2008 PM2.5 Emissions | | Klamath Falls NAA 2017 PM2.5 Emissions | | | |
|---|---|---|---|---|---|---|
| | Annual Emissions | Percent of Total (AE) | Annual Emissions | Percent of Total (AE) | Typical Season Day Emissions | Percent of Total (TSD) |
| | Tons | % | Tons | % | Pounds | % |
| 321219- Reconstituted Wood Product Manufacturing | 65.7 | 46% | 88.7 | 56% | 487 | 49% |
| 321212- Softwood Veneer and Plywood Manufacturing | 48.9 | 34% | 41.2 | 26% | 358 | 36% |
| 221112- Fossil Fuel Electric Power Generation | 19.8 | 14% | 19.6 | 12% | 107 | 11% |
| 327992- Ground or Treated Mineral and Earth Manufacturing | 3.0 | 2% | 2.9 | 2% | 16 | 2% |
| 212321- Construction Sand and Gravel Mining | 0.8 | 1% | 2.7 | 2% | 15 | 1% |
| 423930- Recyclable Material Merchant Wholesalers | 3.1 | 2% | 1.4 | 1% | 7 | 1% |
| 812220- Cemeteries and Crematories | 0.1 | 0% | 1.3 | 1% | 7 | 1% |
| 327320- Ready-Mix Concrete Manufacturing | 0.2 | 0% | 0.5 | 0% | 3 | 0% |
| 928110- National Security | 0.5 | 0% | 0.1 | 0% | 0 | 0% |
| 335999- All Other Miscellaneous Electrical Equipment and Component Manufacturing | 0.0 | 0% | 0.0 | 0% | 0 | 0% |
| 812210- Funeral Homes and Funeral Services | 0.0 | 0% | 0.0 | 0% | 0 | 0% |
| 221330- Steam and Air-Conditioning Supply | 0.0 | 0% | 0.0 | 0% | 0 | 0% |
| 321918- Other Millwork (including Flooring) | 0.2 | 0% | 0.0 | 0% | 0 | 0% |
| 812910- Pet Care (except Veterinary) Services | 0.0 | 0% | 0.0 | 0% | 0 | 0% |
| 326191-Plastics Plumbing Fixture Manufacturing | 1.1 | 1% | 0.0 | 0% | 0 | 0% |
| **Grand Totals** | **143.4** | | **158.5** | | **1002** | |

*Table 3. Klamath Falls Non-Attainment Area 2008 and 2017 Point Source $PM_{2.5}$ Emissions Comparison by NAICS*

A comparison of these activities between 2008 and 2017 indicate that wood products manufacturing and fossil fuel electric power generation are the driving point source activities of 2017 $PM_{2.5}$ emission levels in the NAA. Overall $PM_{2.5}$ emission levels increased by 15 tons from 2008 to 2017 for the point source category. Wood products manufacturing facilities make up 56% of $PM_{2.5}$ annual emissions where fossil fuel electric power generation is approximately half that at 26%. The other 18% of emissions comes from the various industries listed in Table 3 above.

As discussed above, increases in emissions may be due to a better economy in 2017 than in 2008. In 2008, Oregon was experiencing a recession that may explain facilities not operating at optimal capacity and therefore lower emissions in the NAA. Since 2008, changes in production activities and installation of new equipment for some existing facilities may explain the increase of emission levels in the NAA. In addition, eight facilities closed after 2008 likely because of the recession but three new facilities were also add causing some fluctuations in $PM_{2.5}$ emission levels from 2008 to 2017.

# 4. References

1. Oregon Department of Environmental Quality. March 2012. "2014 Attainment Year SIP Emission Inventory for Particulate Matter 2.5 Microns and Smaller ($PM_{2.5}$) Klamath Falls Attainment Area" Volume 3.

2. United States Environmental Protection Agency. May 2017. "Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations."

3. United States Environmental Protection Agency. August 2018. "MOVES2014, MOVES2014a, and MOVES2014b Technical Guidance: Using MOVES to Prepare Emissions Inventories for State Implementation Plans and Transportation Conformity."